

Further Observations on Hybrid Swallowtails

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In November 1952, using the technique of hand-mating (described in *Ent. Rec.*, 64: 98), the hybrid between a female North American Black Swallowtail (*Papilio polyxenes asterius*) and a male Old World Swallowtail (*P. machaon*) was obtained. In February 1953 the reciprocal cross (*P. machaon* ♀ × *P. polyxenes* ♂) was also produced. The salient feature of both these hybrids was that they were black, in this resembling the American parent, but in addition they showed certain definite but less striking *machaon* characteristics.

Since that time it has been found possible to cross more of these North American Swallowtails and the following hybrids have now been obtained, all by hand-pairing.

- P. polyxenes* ♀ × *P. machaon* ♂.
- P. machaon* ♀ × *P. polyxenes* ♂.
- P. brevicauda* ♀ × *P. machaon* ♂.
- P. brevicauda* ♀ × *P. polyxenes* ♂.
- P. polyxenes* ♀ × *P. brevicauda* ♂.
- P. zelicaon* ♀ × *P. machaon* ♂.
- P. machaon* ♀ × *P. zelicaon* ♂.
- P. polyxenes* ♀ × *P. zelicaon* ♂.

RANGE AND BRIEF DESCRIPTION OF SPECIES. (See map and plates).

A. *P. machaon* L.

This insect occurs as various races throughout most of the Old World and extends across the Behring Strait into Alaska, Manitoba and Alberta where it is found in three or four sub-arctic forms. The butterfly is so well known that no detailed description is necessary. There are, however, certain special characteristics which deserve mention because of their importance when describing the hybrids.

1. Ground colour yellow.
2. There is no sexual dimorphism.
3. There is a smudge of yellow on the apex of the forewing on the under-side; this is formed by a powdering of yellow scales.
4. The legs are partly yellow.
5. The eye spot on the anal angle has a thin black posterior border.

6. There is very little or no orange in the four submarginal yellow lunules above the tail on the underside of the hind wings.
7. The full grown larva is green with black transverse bands broken up by a number of characteristic orange spots.

B. *P. polyxenes asterius* Stoll.

The distribution of this butterfly is from Quebec in the north to Louisiana in the south keeping east of the Rocky Mountains throughout its range. It is the Common Black Swallowtail of North America. The special features to be noted are:—

1. Ground colour black.
2. There is marked sexual dimorphism.
3. There is no smudge of yellow on the apex of the underside of the forewing.
4. The legs are black.
5. The eye spot on the anal angle has a round black central pupil.
6. The four submarginal lunules above the tail are almost entirely orange.
7. The full grown larva has yellow spots.

C. *P. brevicauda* Saunders.

This insect is found only in Newfoundland, Nova Scotia, Anticosti Island, Labrador and Quebec. It is a *polyxenes*-like butterfly but the yellow in it is more orange and the tails are very blunt and short. It also differs from *polyxenes* in that there is no sexual dimorphism. The larva resembles that of *polyxenes* in having yellow spots in the last instar.

D. *P. zelicaon* Lucas

This species occurs west of the Rocky Mountains ranging from British Columbia in the north to Arizona and California in the south. It is a large, striking, orange-yellow butterfly with heavy black markings, superficially resembling *machaon* more than *polyxenes* or *brevicauda*. The special characters to be noted are:

1. Ground colour orange-yellow.
2. There is no sexual dimorphism.
3. The apical smudge is present.
4. The legs are black.
5. The eye spot on the anal angle has a central pupil as in *polyxenes* and *brevicauda*.
6. The four lunules above the tail are almost entirely yellow.
7. The larval spots in the last instar vary between yellow and yellow-orange.

ANALYSIS OF THE HYBRIDS.

- I. *P. polyxenes asterius* Stoll ♀ × *P. machaon* L. ♂. (Called hybrid "O").

The special features to be noted are:

1. Ground colour black as in *polyxenes*.
2. There is marked sexual dimorphism.
3. The yellow smudge on the apex of the forewing on the underside is present but less marked than in *machaon*.
4. The legs are partly yellow but less yellow than in *machaon*.

- 5 The eye spot on the anal angle is intermediate but resembles the narrow marginal black arc of *machaon* more than the central pupil of *polyxenes*.
- 6 The four submarginal lunules above the tail are yellow streaked with orange.
7. The full-grown larva has orange spots.

Number of times hybrid obtained:—Five.

Numbers and sex ratio:—

		♂♂	♀♀
"O" 1	64	40	24
"O" 2	20	11	9
"O" 3	13	7	6
"O" 4	3	1	2
"O" 5	2	2	1

Length of life cycle at 70° F. from laying of first eggs to emergence of first insects:—33 days.

*Fertility:—No fertile eggs have been obtained from numerous crossings *inter se*. A ♀ *P. machaon* mated with a ♂ "O" 5 laid 29 eggs of which 23 are fertile (9.8.53). Previous similar pairings have always been infertile and up to the present time no fertile eggs have been obtained from back crosses to *polyxenes*.

11. *P. machaon* L. ♀ × *P. polyxenes asterius* Stoll ♂. (Called hybrid "R").

Description. Similar to "O" but cross appears less fertile. Hybrid features as in "O", the yellow in the submarginal lunules being especially marked.

Number of times hybrid obtained:—Three.

Numbers and sex ratio:—

		♂♂	♀♀	Gynandromorphs.
"R" 1	7	2	5	
"R" 2	6	2	2	2
"R" 3	13	7	6	

Length of life cycle at 70° F. from laying of first eggs to emergence of first insects:—38 days.

Fertility:—Fertile F.1 matings have not been obtained from "R" hybrids *inter se*, nor from "O" × "R" matings ("O" ♀ × "R" ♂ and "R" ♀ × "O" ♂).

All possible matings have been done between "O" and "R", most of them several times, and all have proved infertile. With the back crosses, however, fertile eggs have been obtained on two occasions, once with a ♂ *polyxenes* and once with a ♂ *machaon*.

- a. The Back Cross to *Polyxenes*. (♀ "R" hybrid × ♂ *polyxenes*, March 1953).

Twenty eggs were obtained from this mating but only four proved fertile; from them four imagines were bred, all females. The

*In all cases infertility has only been assumed where the butterflies have been successfully hand-paired

b. *The Back Cross to Machaon.* (♀ "R" hybrid × ♂ *machaon*, March 1953).

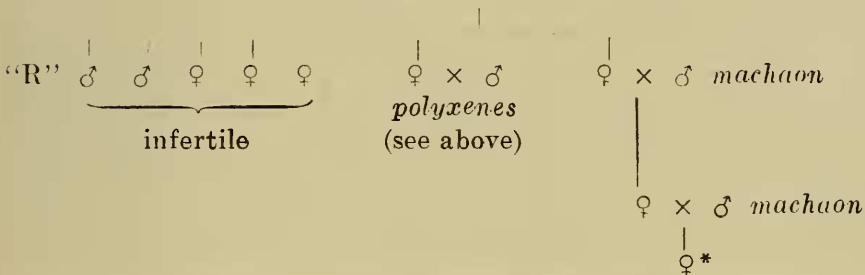
Six eggs were laid but only one was fertile. From this was bred a very large female butterfly resembling *machaon*, except that the anal spot was hybrid-like.

Length of life cycle at 70° F.:—37 days.

Larval spots in last instar:—Orange.

Fertility:—This butterfly was mated to a male *machaon* and laid ten eggs. Seven of these darkened but only one hatched. From this was bred a female butterfly the parentage of which is given below.

♀ *machaon* × ♂ *polyxenes*



**Description*:—Resembles *machaon*, except that the anal spot is hybrid-like. Normal *machaon* size.

Length of life cycle at 70° F.:—37 days.

Larval spots in last instar:—Orange.

Fertility:—Mated to male *machaon*. Laid about twenty-five eggs; most hatched but big larval death-rate from virus disease and only one pupa obtained (3.8.53).

III. *P. brevicauda* ♀ × *P. machaon* L. ♂. (Called "brevimach").

Description:—The male appears identical with the "O" or "R" hybrids. The black background of *brevicauda* replaces the yellow of *machaon* as does the black of *polyxenes*, but the specific *brevicauda* features (short tails and orange spotbands) have disappeared. The tails of the hybrid are long, the spotbands are of the *machaon* yellow, the anal spot is hybrid-like, the legs are partially yellow and the butterfly has the hybrid smudge. Sexual dimorphism is absent, in this differing from the "O" and "R" hybrids. The larval spots in the last instar are orange.

Number of times hybrid obtained:—Two.

Numbers and sex ratio:—

	♂♂	♀♀
"Brevimach" 1	1	—
"Brevimach" 2	—	2

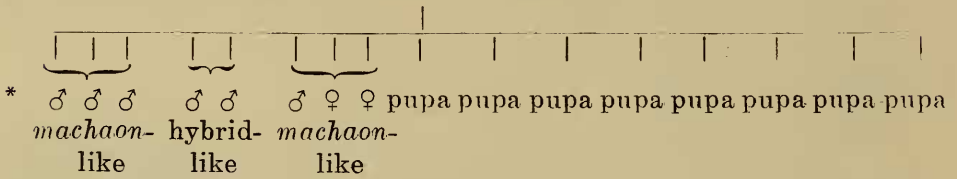
Length of life cycle at 70° F.:—38 days.

Fertility:—There have been no fertile eggs from an *inter se* pairing, but a fertile mating was obtained between the male "brevimach" and a female *machaon*. She laid about twenty-five eggs which were fertile except for two or three.

The Back Cross to *Machaon*. ($\text{♀ machaon} \times \text{♂ "brevimach"}$).

Result of this mating (in order of emergence:—

$\text{♀ machaon} \times \text{♂ "brevimach" 1.}$



**Description*:—It will be seen that among the butterflies that have so far emerged a clear-cut segregation has occurred in respect of ground-colour, the butterflies either looking like *machaon* (yellow ground colour) or like the hybrid (black ground colour). Two of the *machaon*-looking insects resembled *machaon* exactly; in the other four the anal spot was hybrid-like. Both black butterflies exactly resembled their hybrid father, except that in one the anal spot was *machaon*-like. No black females have yet emerged but there is no sexual dimorphism among the yellow individuals. The larval spots in the last instar are orange.

Length of life cycle at 70° F.:—39 days.

Fertility:—*Inter se*: a fertile brother-sister mating was obtained between the hybrid-looking male with the *machaon*-like spot and a *machaon*-like female. Four eggs were laid, two of which were fertile; the larvae from these died of virus disease when half grown. The same hybrid-looking male was also mated to a female *machaon*. She laid thirteen eggs, ten of which were fertile and from these four pupae have been obtained.

IV. *P. brevicauda* ♀ × *P. polyxenes* ♂. (Called "bras").

Description:—The male is very similar to *polyxenes*, the tails being long and the spotbands on the upper side yellow, thus markedly differing from *brevicauda* (see p. 2). On the underside of the forewing the orange inner spotband is broad as in *brevicauda*. In the female the orange has also given place to yellow and the spotband on both upper and underside is intermediate between that of *polyxenes* which is narrow and faint, and that of *brevicauda* which is broad and striking. The male and female hybrids are the same size, thus differing from *polyxenes*, and in general the sexual dimorphism is intermediate. The larval spots in the last instar are yellow.

Number of times hybrid obtained:—One.

Number and sex ratio:—

	♂ ♂	♀ ♀
15	7	8

Length of life cycle at 70° F.:—34 days. (Females emerged first).

Fertility:—No fertile eggs were produced from *inter se* matings. Two fertile back crosses were obtained with *polyxenes* and *brevicauda* females respectively.



Fig. 1. ♂ *P. machaon*. The ♀ is similar.
Note light ground colour and character of anal spot.



Fig. 2. ♀ *P. polyxenes*.
Note black ground colour and central anal pupil. The upper side of the ♂ *polyxenes* is similar to Fig. 3 except for the character of the anal pupil (see text). Marked sexual dimorphism.



Fig. 3. ♂ "O" Hybrid.
Note character of anal spot.



Fig. 4. ♀ "O" Hybrid.
Note sexual dimorphism and character of anal spot.



Fig. 5. ♀ *P. brevicauda*.

Note short blunt tails, wide inner spot-band, and character of anal pupil.
The ♂ is similar.

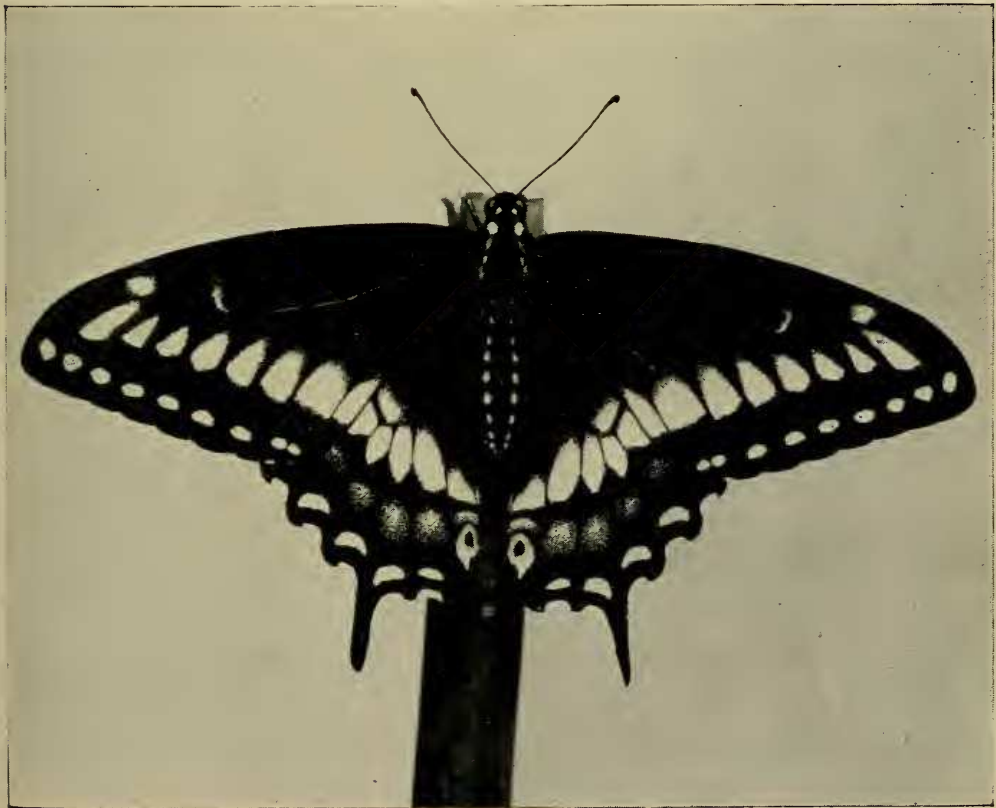


Fig. 6. ♂ "Bras".

Note wide inner spot-band as in *brevicauda* and long tails as in *polyxenes*.



Fig. 7. ♀ "Bras".
Sexual dimorphism intermediate between *brevicauda* and *polyrenes*.



Fig. 8. ♂ "Brevimach".
Note resemblance to Hybrid "O".



Fig. 9. ♂ *P. zelicaon*.

Note general similarity to *machaon* but heavier black markings and central anal pupil.

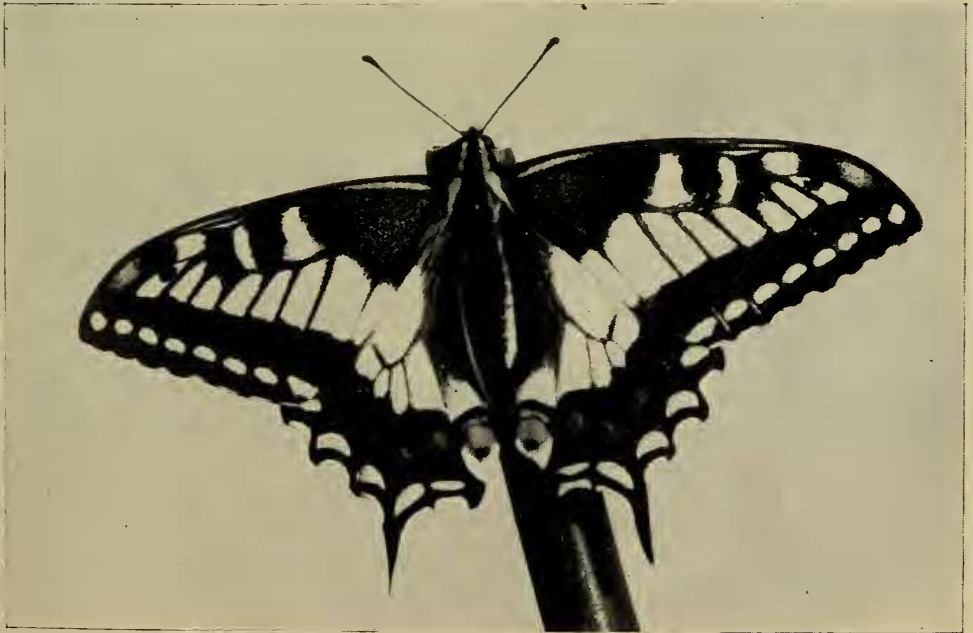


Fig. 10. ♀ "Zelimach".

Note hybrid-like type of anal spot.

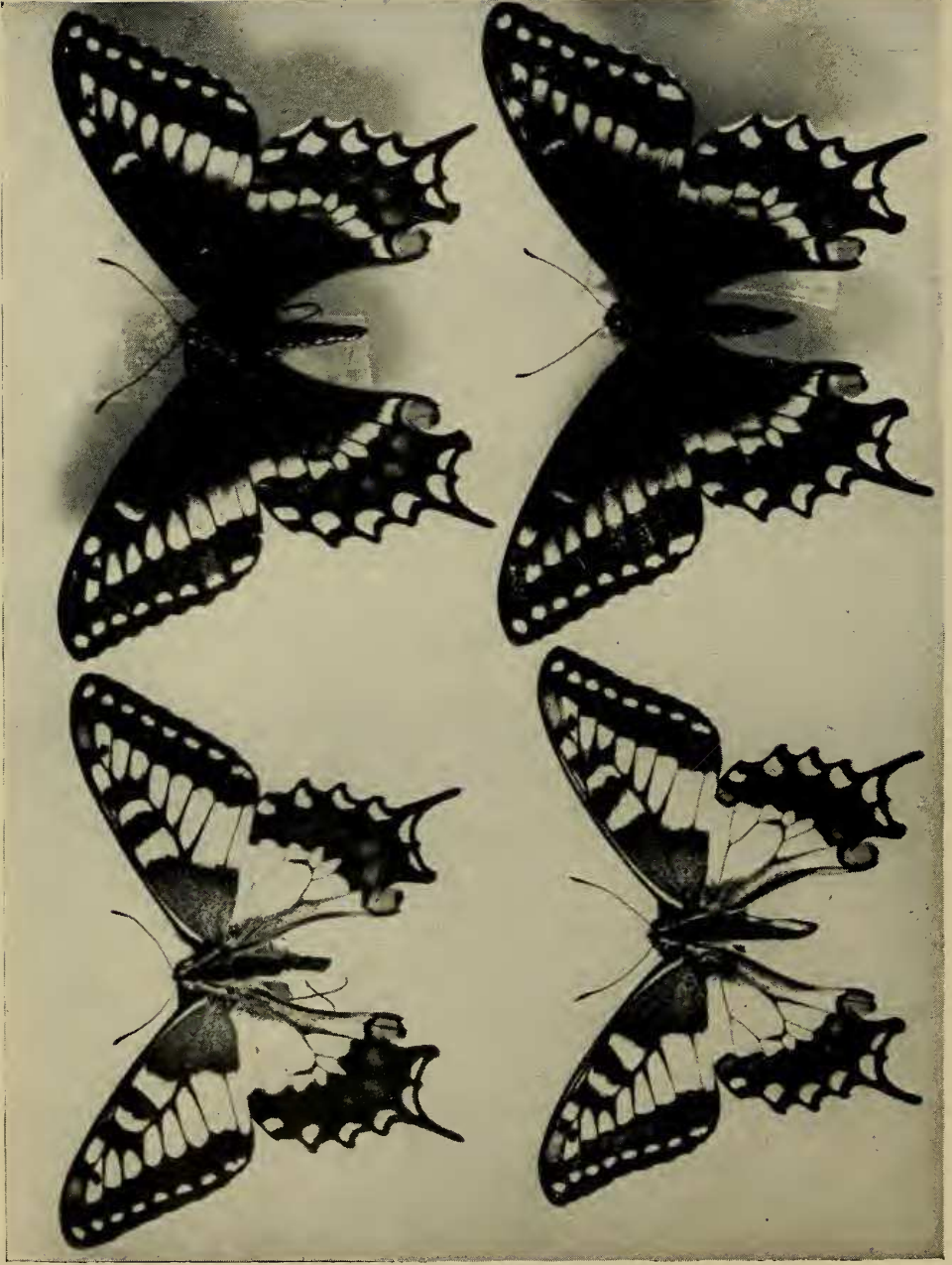


Fig 11. Offspring of ♀ *machaoon* × ♂ "*brevimach*", showing segregation in respect of ground colour.